areas immediately northeast, east, and southeast of the buildings. Most non-storm water discharges to Kings Creek had been eliminated by mid-1970s. Septic systems were also constructed for Buildings E3266 and E3234. The Building E3265 chemical sewers were equipped with an underground holding tank that was reportedly connected to the sanitary sewer at a later date. The chemical sewer servicing Building E3100 was constructed with an underground neutralization tank. The Building E3100 chemical sewer is no longer in use. The Building E3081 sewer system was constructed with a neutralization tank and connected to the sanitary sewer. It is unknown if this tank has ever been operated as a neutralization unit. A sump (Hazardous Materials Facility (HMF) Number 64/Record Number 91707) located at Building E3236 was identified as too hazardous to sample (Argonne, 1994).

Three incinerators were constructed at the laboratories and most solid wastes generated were incinerated. One is located on the east side of Building E3081. Two incinerators were located west of Building E3236 and were demolished in 1986. Animal bedding, animal carcasses, and small amounts of infectious laboratory waste such as needles, gauze, and used plastic beakers were the most common types of waste accepted for incineration. Ash was tested for Extraction Procedure Toxicity and disposed off-post (USAEHA, 1989). A 275-gallon tank behind Building E3236, originally thought to contain laboratory waste (Argonne, 1994), is an active sewage lift station for the 32XX area (Weston, 1999); thus could not be abandoned. A 2,000-gallon steel holding tank (HMF #91541) on the east side of Building E3222 was closed in 1989 (Weston, 1998) and later removed in 2000 (Weston, 2000b).

EACC3D – Building E3160 Complex – Site EACC3D comprises 19.6 acres east of Building E3100 at the end of North Kings Creek Road, including Building E3160. Structures in this complex were built during WWII. Building E3160 was originally used as a medical research physics laboratory primarily for wound assessment (Wound Ballistic Program). A variety of research has been performed in other complex facilities including fuel mixing and toxic laboratory work (Building E3175), incendiary research (Building E3170), and animal studies (Buildings E3162, E3164, and E3165). Current activity at the site is minimal, with smaller structures either abandoned or used for storage.

Major structures in this area are connected to the sanitary sewer system. Many of the existing and former smaller structures were not served by sewer systems. A French drain and sewer system is located at the site of former Building E3178; discharge from the sewer is several hundred feet southeast of the building site. Building E3175 has a holding tank and wastewater system that discharged a short distance west of the building into a ditch leading to Kings Creek. A UST containing acid waste was reported to be located east of Building E3161 however, a field investigation of HMFs conducted by Argonne (1994) indicated that the acid waste UST does not exist.

In 1992, Buildings E3164, E3165, E3176, and E3177 were demolished and Building E3170-A was relocated. Environmental sampling was performed directly beneath the removed buildings and results indicated no analyte detection with the exception of metals. Site EACC3D was originally considered a potential No Further Action (NFA) site. However, the Ecological Risk Assessment (ERA) concluded that a potential risk exists, so the site was added to this volume of the RI.

EACC3E – Building E3300 Laboratory Complex – Site EACC3E encompasses approximately 19.4 acres along the east side of Ricketts Point Road and north of Beach Point Road. It consists of the Building E3300/E3330 Laboratory Complex. Original facilities at this site were constructed during 1941 and 1942. The last of the structures were built in the mid-1960s. Building E3300 was built in 1965 and was referred to as the "supertoxic laboratory". Several of the WWII structures (storage buildings, magazines, small research laboratories, etc.) were demolished to make room for the construction of newer buildings or were converted to laboratories.

The complex was built for research and development work related to chemical warfare. According to the RFA, primary mission responsibilities of the facility have not changed. Activities at the complex have involved the use of toxic chemical agents, agent detection chemicals, decontamination chemicals, explosives compounds, pyrotechnic mixes, and obscurant smokes. Support activities at the site related to laboratory research and development work include a machine shop, materials storage facilities, hazardous waste accumulation sites, a heating plant, and a wind tunnel. Of these, Building E3334 was used a flammable materials storage facility and a storehouse for various types of chemicals. In 1975, this building was assigned to the Physical Chemistry Branch and according to personnel responsible for the removal and clean up operations of the chemicals stored in Building E3334, it took 4 to 5 days to remove the chemicals and clean the building. Broken bottles and spilled chemicals were common observations. It was reported that odors emanating from the building required personnel to wear masks during the clean up operations. The walls and floors were flooded with water by the Fire Department and the floor was later washed with a muratic acid solution in an effort to eliminate the obnoxious odors. There is little documentation regarding the types of chemicals that were stored (EAI, 1991).

Buildings were originally serviced by a combination of sanitary sewers and chemical sewer/storm drains. Laboratory wastewater was discharged from the chemical sewer connected to the storm sewer leading into Kings Creek. Decontamination of chemical warfare agents was required prior to disposal in chemical sewers. Major modifications to the chemical sewer system were made in the 1980s to tie it into the sanitary sewer. Additionally, a wastewater holding tank

(CO HMF Number 9/Record Number 91549) is located at Building E3348 with an associated steel inlet pipe. The tank and inlet pipe were removed in 2000 (Weston, 2000b).

EACC3F – Building E35XX Area – Site EACC3F comprises approximately 14.8 acres southeast of the intersection of Ricketts Point Area and Beach Point Road. Many of the buildings at this site were constructed during the WWII era. Building E3516 was constructed as an experimental fabrication facility. Building E3528 was used for sandblasting, but no longer stands. Building E3500 was built in 1943 as a warehouse, a laboratory, and an environmental test chamber complex. Smoke work has been conducted in this facility in recent years. The northern portion of Building E3510 was constructed during 1953 and the southern portion was constructed in 1983. The building has been used primarily as a research laboratory related to physical protection. Recent work in Building E3510 has been related to munitions development and detection of chemical agents. The Building E35XX Area contains a number of small laboratories and environmental test/surveillance chambers in which a variety of equipment and chemical materials have been tested, including chemical warfare agents.

The Building E35XX Area was serviced by a combination of sanitary and chemical/storm sewers. Historical drawings indicate that Building E3510 was equipped with a caustic scrubber system and a wastewater flow equalization tank in the early 1950s. The flow equalization tank was located southeast of the original structure and was connected to a chemical/storm sewer that discharged to the marsh south of the building. Sewer upgrade plans from 1976 show that the tank was to be abandoned and replaced by a limestone-filled neutralization tank with connection to the sanitary sewer system. It is unknown if the flow equalization tank was abandoned or modified for use as the neutralization tank. In 1989, employees in Building E3510 reported that a brownish oily substance was seeping into Room 30 through the floor. A wipe sample of this material revealed the presence of an alkyl phenolic compound which was not hazardous. Concern about the seepage was heightened by reports from Edgewood personnel that the southern wing of Building E3510 was built upon an area where laboratory chemicals were buried. In December 1989, the drain lines from the building were tested and found to be leaking. The floor drains were plugged by December 28, 1989. Additionally, until the early 1970s, Building E3516 had no formal method of disposing of waste products after plating room operations. Waste materials were simply diluted heavily with water and washed down the storm drains which are believed to have also discharged to the marsh to the south of the building (EAI, 1991). During the 1970s and 1980s, chemical wastewater discharges to surface water were eliminated when chemical sewers were connected to the sanitary sewers.

A wide variety of wastes were produced by the facilities in the Building E35XX Area. However, except for the Building E3516 (Experimental Machine Shop), most of the facilities would have produced only small quantities of wastes. The ground surface elevation of this site ranges from

roughly 15 to 20 ft above msl, and surface water drainage is south to Wright Creek, which discharges to the Gunpowder River to the southwest. No recent removal actions have been documented for this site.

EACC3G – Building E360X, E361X, E362X Area – Site EACC3G encompasses approximately 8.2 acres along the north side of Beach Point Road, east of the Building E3330 Laboratory. Structures in this area were built after WWII and have been used for offices, laboratories, and material storage. There is insufficient information concerning the types of laboratory and other research and development work conducted in this area; however, some of the reported laboratory work involved the use of pyrotechnic materials. Remains of process and/or test equipment are located in the northeast area of the site. The equipment was installed during the 1950s, but its use is unknown.

Wastewater from the site may have been discharged through the combination chemical/storm sewers. Site inspections revealed possible discharge pipes located in a drainage ditch near Building E3613 and in an area south of Building E3619. Two possible drum storage racks are located approximately 40 ft east of Building E3619. Immediately north of the Building E3605 water tower is an area of minor depressions, mounds around the trees, and surface debris.

No recent removal actions have been documented for this site.

EACC3I – Building E3570 Assembly Plant – Site EACC3I comprises approximately 7.7 acres along the south side of Beach Point Road, east of the Building E3560 Test Chamber Complex. The facility was constructed in 1953 as a munitions assembly plant. It has been used for production of fire bomb clusters and for vehicle decontamination testing. Building E3570 has also been used as a laboratory. Machining-and assembly-type work has continued at the site into recent years. Material storage areas at the site include a drum rack southeast of Building E3570, a storage building immediately north of the drum rack, and hazardous waste satellite accumulation sites within the building. The drum rack has not been used since 1988. No recent removal actions have been documented for this site.

EACC3J – Building E3580 Pyrotechnic Loading Facility – Site EACC3J encompasses approximately 3.6 acres along the south side of Beach Point Road, east of the Building E3570 Assembly Plant. Most of the site structures were built in 1951 and 1952. The facility was placed into service in 1952 and has been used continuously for research, development, and evaluation of pyrotechnic mixtures, loading procedures, and munitions into which the mixtures are loaded. Work cubicles along both sides of the building are used for experimental pyrotechnic research and small-scale item fabrications. A personnel emergency dive tank was previously located immediately north of Building E3580. Buildings E3581 and E3582 serve as 90-day temporary

storage facilities for reactive wastes. The area south of E3580 has been used for storage of materials (mostly solids) in small structures and conex containers.

Facility wastewater was carried by a sanitary sewer system, drainage troughs, and storm drains. Wastewater discharged from toilets, sinks, showers, and floor drains is discharged to the sanitary sewer systems. Cubicle washout wastewater is collected in small troughs located along the edge of the concrete pads adjacent to the north and south sides of E3580. This water is then drummed and analyzed for proper disposal. Laundry wastewater is collected in a small tank for later analysis and disposal. Prior to 1986, wastewater from cubicle washout and the laundry was handled differently. Cubicle washout wastewater was allowed to flow to the ground surface adjacent to the building. Laundry wastewater was discharged to the sanitary sewer system. Perchlorate contamination found in monitoring CC-135A is likely from either the direct discharge of cubicle wastewater to the ground surface or from testing in an open area southeast of Building E3580.

The ground surface elevation at the Building E3580 Pyrotechnic Loading Facility is between 15 and 22 ft above msl. Surface water drainage from within the fenced compound is to a shallow ditch immediately outside the east fence, which carries the runoff north and east to Kings Creek. Recent actions include the removal of PCB-contaminated soil in 1992 surrounding Building E3580 (R&R International, Inc. 1992).

EACC3K-A – Building E3700 Complex – Site EACC3K-A comprises approximately 4.55 acres north of the intersection of Beach Point Road and 57th Street. Principal structures in this complex include Buildings E3724, E3726, and E3728. These structures were constructed during 1942 and 1943 for use as new pilot plant facilities. Support structures added in 1945 include Building E3723 (a pilot filling tower), Building E3721 (a pilot mixing building), and Buildings E3740, E3741, and E3742, which are all storage magazines. Building E3714, constructed during 1942 and 1945, was used for surety work either as a mixing building or to conduct experimental filling during the period of 1942 to 1945. The building was demolished in the 1960s; however, no records are available on the demolition project. The Building E3700 Pilot Plant facilities were used for experimental filling rather than process work. It is possible that pilot scale manufacturing of nitrogen mustard was performed in these facilities. Experimental filling of plasticized white phosphorus (WP) was performed in Building E3724 during WWII. Charcoal grinding was conducted in Building E3724 during the early 1960s. Building E3726 was originally used as a production facility for ground rubber, storage, office area, and change house. It was also used for the production of steam for the complex until steam lines from Building E3216 were connected.

A test chamber and air scrubbers were constructed at Building E3726 during the early 1960s. Test chambers were also built at Buildings E3724 and E3728 during the 1970s. The Building E3726 chamber has been used primarily for chemical agent and chemical agent simulant testing, while the other two chambers have been used primarily for pyrotechnic and smoke testing. Another activity performed in the Building E3700 complex area for many years was environmental test surveillance.

The three main buildings were connected to a chemical sewer system that discharged wastewater to ditches immediately north of the complex. Runoff from the ditches leads to Kings Creek. A 500-gallon underground wastewater tank (CO HMF Number 16/Record Number 91563), located inside Building E3728, was identified as too hazardous to sample (Argonne, 1994). Two decontaminating agent USTs (1,000 and 3,000 gallons) are located east of Building E3724. One 5,000-gallon glass-lined steel wastewater HMF (CO HMF Number 15/Record Number 91560), installed in 1968, is located east of Building E3726. In 1987, an additional 5,000-gallon glass-lined steel wastewater UST was installed east of Building E3728. Argonne (1994) investigated the HMFs and determined the contents to be free of chemical agents and not hazardous, as determined by comparison of the analytical results with the characteristics for RCRA hazardous waste. However, no subsurface investigation was performed by Argonne. The HMFs (old and new) at Building E3726 are no longer used. Discharge from all of these wastewater tanks was carried through the chemical sewers to Kings Creek. In 1981, the chemical sewer system was connected to the sanitary sewer system.

Wastes generated from the test chambers would have included decontaminated chemical agents and residues from pyrotechnic material. Aerial photographs from 1943 show an area of possible waste disposal along a small tributary of Kings Creek east of Building E3724. Subsequent photographs suggest that the tributary has been filled, leveled, and overgrown with trees. The ground surface elevation in the Building E37XX Complex area is about 20 ft above msl, and surface water runoff is northward to nearby Kings Creek. The 500-gallon underground wastewater tank located inside Building E3728 was filled with flowable fill by ERDEC (no date provided) (Weston, 1999).

EACC3K-B – B-Field Kings Creek Dump Site – Site EACC3K-B encompasses approximately 46.8 acres southwest of Kings Creek, north, and east of Building E3700. It is within the EACC3K site and associated with the Building E3700 Complex. Demolition debris, chemical material, and miscellaneous items associated with the Building E3700 Complex were dumped at the B-Field Kings Creek Dump Site. The site is a forested area; however, removal of the forest floor in several places revealed very dark ash, which is consistent with other test pits in the area. Based on historical information provided in the RFA (USAEHA, 1989), the most likely chemicals elevated at the site are metals from waste, although a number of other chemicals could

be present [including bagged o-chlorobenzylidene malononitrile (CS), a tear agent]. Evidence of disposal is from visual observation. No recent removal actions have been documented for this site.

EACC3L – Building E3640 Process Laboratory – Site EACC3L comprises approximately 4.4 acres on the north side of Beach Point Road, northeast of Building E3570. The process laboratory facilities were constructed in 1951/1952 and used from 1952 until 1978. Most of the work at the site involved the preparation of materials or the evaluation of production processes. Research involving the disposal of chemical agents was also performed at Building E3640. The Building E3640 complex is scheduled for demolition in FY07.

Chemicals and solid wastes were stored at drum racks northeast and west of Building E3640 and inside Buildings E3640 and E3642. The RFA states that no solid wastes were disposed on site. An inspection of Building E3640 Process Laboratory facility was performed during the May 1986 through 1989 time period. The only visual evidence of possible hazardous material release to the environment was an area bare of vegetation adjacent to the north side of the drum storage area, northeast of Building E3640. This area extends downslope, to the north-northeast, from the north side of the concrete drum storage area for a distance of roughly 15 to 20 ft.

Most liquid wastes generated at the process laboratory were discharged to the chemical sewer system. Wastewater was collected from working bays on the north side of Building E3640 and from caustic scrubbers in Building E3641. Three below-floor sumps were located in Building E3640, and a 'toxic sump' was located in Building E3641 (EAI, 1991). Two sumps (CO HMF Number 12/Record Number 91555 and CO HMF Number 13/Record Number 91556) located inside Building E3640, were identified as too hazardous to sample (Argonne, 1994). Both sumps were connected to the flow-through sump (CO HMF Number 14/Record Number 91557) which was located northeast of Building E3640. Effluents from these sumps were discharged into an open ditch approximately 190 ft northeast of the Building E3640 flow-through sump. Wastewater was then carried northward in the open ditch to a branch of Kings Creek.

In March 1995, the sumps inside Buildings E3640 and E3641 were filled with cement-stabilized flowable fly ash material (R&R, 1995). Later in November 1995, approximately 310 tons of contaminated soil and 165-feet of 6-inch diameter vitrified clay wastewater pipeline were removed from the site (Foster Wheeler, 1996). During this effort, approximately 700 gallons of liquid waste was also removed from the exterior sump located north of Building E3640, and the sump was filled with flowable fill (Foster Wheeler, 1995).

The ground surface elevation at this site is between 15 and 20 ft above msl. Surface water drainage is to the north into a marsh associated with Kings Creek, which is roughly 1,000 ft north of the facility.

EACC3M-A – Wastewater Treatment Plant – Site EACC3M-A encompasses 8.8 acres at the eastern end of Beach Point Road, southwest of the Beach Point peninsula. Original portions of the wastewater treatment plant were constructed during 1941 and 1942. The plant was upgraded at least twice (1960s and 1980s) to provide improved treatment systems. Two trickling filters (Buildings E3956 and E3960), two secondary sedimentation tanks (Building E3958), and a chlorine contact chamber (Building E3954) were added during the 1960s upgrade. In the 1980s, additional improvements including neutralization facilities, chlorination facilities, dechlorination facilities, reaeration facilities, and gravity sand filters were added to the system. The plant is still in operation.

Some chemical plant wastewater systems were connected to the treatment plant during WWII. Most significant of these was the Building E5238 Clothing Impregnating Facility (EACC2C). Very high concentrations of 1,1,2,2-tetrachloroethane, along with other organic chemicals, were contained in wastewater discharged from that facility. It is possible that wastewater discharged from other chemical facilities to the treatment plant contained significant concentrations of hazardous chemicals.

Until the 1970s and 1980s, most of the chemical sewers at APG-EA were not connected to the wastewater treatment plant. Efforts were made to eliminate chemical sewer discharge to surface water during that time. Chemical sewers from facilities such as chemical laboratories east of the airfield, the Building 87 Pilot Plant, and the Building E5188 WP Filling Plant were connected to the sanitary sewer system. Limiting or eliminating disposal of certain chemical wastes through the sewer system was required by U.S. Army policy and environmental regulations during this time. Wastewater characterization and biotoxicity study work during the mid- to late- 1980s indicated that there were no significant discharges of hazardous constituents from the treatment plant (USAEHA, 1989). No recent removal actions have been documented for this site.

EACC3N – Beach Point Test Site – Site EACC3N comprises 11.9 acres at the eastern end of Beach Point Road and includes the upper peninsula, areas south of Beach Point, and areas southeast of the APG-EA wastewater treatment plant. The site was used for several types of military testing work. These tests and approximate timeframes include, firing tests of 4.2-inch mortar rounds (1940s) and performance tests for pyrotechnic devices and smoke generators (1945-1970). Wastes generated from these tests were discharged directly to Bush River. Buildings located at the test site were used as small-scale chemical agent storage facilities (primarily G-nerve agents), laboratories, storehouses, offices, and machine shops. Several of

these structures were built with sewer systems that discharged to Kings Creek and Bush River. Buildings E3862 and E3864 were constructed with a shared septic system. Many structures have been demolished or were removed to other locations. Remaining buildings at the south end of the site are either empty or used for storage. Materials stored in these structures included wastewater treatment plant supplies (Building E3861), pyrotechnic research materials (Building E3870), and nonhazardous liquid waste (Building E3872). The northern 6.1 acres (i.e., peninsula) was addressed by a ROD in 1997.

EACC3O – B-Field Range – Site EACC3O encompasses approximately 54.2 acres along the south side of Beach Point Road, between the wastewater treatment plant and the Building E3580 Pyrotechnic Loading Facility, and extends approximately 1,000 ft south toward Bush River. The site was used as an impact area for mortar and artillery testing from the A-field firing point during the 1920s. The RFA reports that B-Field may have been the site of GA agent storage some time in the late 1940s. The exact location of this storage site is not known with certainty. There is no information to indicate that there are SWMUs from the pre-WWII activities in the B-Field Range Area. A 1953 map shows three unnumbered structures to have been located but inspection of this site reveals no evidence of the structures. Inspections for the RFA identified two debris dumping sites, located southeast of Building E3580 and along a trail leading south/southeast from Beach Point Road between Building E3580 and the wastewater treatment plant. Debris observed at these sites included empty drums, concrete blocks, an engine cylinder head, and other miscellaneous materials. It is not known if agent-filled containers or other hazardous materials were buried at these locations. No recent removal actions have been documented for this site.

EACC3P – Mosquito Test Grid Area – Site EACC3P comprises approximately 8.8 acres east of Ricketts Point Road, between Chevron Road and Clearview Drive. The Mosquito Test Grid Area is south of Building E2100. It consists of approximately 82 ponds, which were used in the late 1960s for the development of pesticides for mosquito control. There is little documentation concerning the test grid and no recent removal actions are documented for this site.

1.5 Previous Investigations

This section summarizes previous investigations associated with the thirty-five soils sites, including the RFA, USGS hydrogeologic assessment, Argonne National Laboratory (ANL) investigations, and Hazardous Material Facility (HMF) characterization and closure activities.

1.5.1 Resource Conservation and Recovery Act Facility Assessment

The RFA, completed in 1989, is a detailed source of information on historical operations at the CCSA and the other surrounding areas of APG-EA. This report discusses chemical

manufacturing, laboratory activities, chemical storage, and disposal of toxic chemicals and wastes. A significant portion of the RFA is also dedicated to the interpretation of historical aerial photographs (including photographs of the CCSA Plants Areas dated from 1929 through 1981).

1.5.2 United States Geological Survey Hydrogeologic Assessment

The USGS conducted a detailed hydrogeologic assessment of the CCSA from 1986 through 1989 (USGS, 1989). This investigation was intended to meet the regulatory requirements for a RCRA Facility Investigation under RCRA. The hydrogeologic assessment included the installation and sampling of 149 observation wells at 75 sites within the CCSA. Test borings were logged using down-hole, geophysical methods. Water levels were collected from all of the wells on a periodic basis. Groundwater samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic analytes. The groundwater sampling program indicated extensive chlorinated solvent contamination in various portions of the CCSA. Groundwater contamination in the CCA is being addressed under sites EACC4A and EACC4A-B. Groundwater samples were analyzed for ten of the fifteen KCIA sites and data summaries are included in this RI and discussed in Section 4.37.

1.5.3 Argonne National Laboratory Investigation

ANL conducted numerous geophysical investigations, a field investigation of HMFs, and several contamination source reviews for the CCSA. The results of these studies were used to develop removal action strategies for the sumps and HMFs throughout the CCSA.

1.5.4 Remedial Investigation Progress Report

The JEG report entitled *Canal Creek Study Area Remedial Investigation Progress Report* (hereafter referred to as the *RI Progress Report*) provides the status and findings from the first phase of the RI for 47 IRP sites and the CCA. The conduct of the site-wide Phase I CCSA RI was from 1993 to 1995. Under the JEG RI, analytical data were obtained for over 150 groundwater and 900 soil, sediment, and surface water samples. The RI hydrogeologic investigation confirmed the findings of previous hydrogeologic studies at CCSA, indicating the existence of several VOC plumes in the groundwater system. The principal contaminants that exceeded RI comparison criteria for soil, surface water, and sediment consisted of relatively uniform concentrations of polycyclic aromatic hydrocarbons (PAHs), pesticides, and metals. The findings of the *RI Progress Report* (JEG, 1995b) are summarized in Section 4.0 of this report.

1.5.5 Hazardous Material Facility Characterization and Closure

Roy F. Weston, Inc. (now referred to as Weston Solutions, Inc.) was contracted by APG in 1998 to evaluate potential removal actions to be taken at 59 HMFs (sumps and USTs) throughout the CCSA (Weston, 2000b). Of these, 13 were originally selected for removal and 9 were selected for abandonment (cleaned in place and filled with grout).

Two of the HMFs planned for removal (i.e., HMFs E5604A and E5604B) were changed to abandonments once the area was excavated and the actual size of the tanks was realized. In addition, a 100-gallon flow-through sump associated with Building E5317 could not be located; thus, it was not removed as planned. The ten HMFs removed during this effort were associated with Buildings E3222 (EACC3C) (2,000-gallon wastewater holding tank), E3348 (EACC3E) (285-gallon wastewater holding tank), E5282 (EACC1L-B) (two 2,000-gallon wastewater holding tanks and two detoxification sumps), E5440 (EACC1H-G) (large holding sump), E5476 (EACC1H-F) (one flow-through sump and one collection sump), and E5483 (EACC1H-C) (flow-through sump). These actions will be discussed in detail in conjunction with their respective AEDB-R sites in Volumes I through IV of this RI Report.

1.6 Related Work Plans and Risk Assessment Documents

The RI investigation and follow-on risk assessment sampling activities were conducted in accordance with the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988), the FFA (dated March 27, 1990), and the following work plans:

- *Generic Work Plan for CERCLA Remedial Investigation/Feasibility Study.* US Army Corps of Engineers (USACE), 1992];
- *Generic Work Plan for CERCLA Remedial Investigation/Feasibility Study.* (Appendix J. Standard Operating Procedures) (USACE-WES, 1999);
- *Site-Specific Health and Safety Plan Addendum #89* (GP, 2004a) to the *Generic Health and Safety Plan* (GP, 1997);
- *Work Plan for Canal Creek Area DSERTS Sites at US Army Aberdeen Proving Ground, Maryland* [EA Engineering, Science, and Technology, Inc. (EA), 2003];
- *Work Plan for the Potential Source Definition Study (Phase III Remedial Investigation)* (GP, 2004b); and,
- *Quality Assurance Project Plan for the Potential Source Definition Study (Phase III Remedial Investigation)* (GP, 2004c).

Several risk assessment documents were also developed in support of this RI, including:

- *Screening-Level Ecological Risk Assessment and Baseline Risk Assessment Problem Formulation for DSERTS Sites in the Canal Creek Study Area, Volumes I through IV* (EA, 2005 – 2006);
- *Human Health Risk Assessment (HHRA) Approach Document for the Proposed DSERTS Action Sites* (EA, 2006a);
- *Baseline HHRA for DSERTS Sites in the Canal Creek Study Area: Volume IV: King's Creek Industrial Area* (EA, 2006j); and,
- *Data Evaluation and Risk Characterization (DERC) for DSERTS Sites in the Canal Creek Study Area, Volume IV: King's Creek Industrial Area* (EA, 2006k).

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2.0 RI/FS PROGRAM SUMMARY

This section summarizes the RI program and provides an overview of certain common program elements (e.g., environmental media sample collection, chemical analyses, and geological investigations) and other components (e.g., geophysical surveys, data management, and removal actions), including the rationale and approach used.

Available site-specific historical, geographic, geologic, and hydrogeologic information was evaluated to develop field characterization techniques and sampling network designs for this project. In addition, field characterization techniques and sampling schemes were selected after evaluating potential contaminants, sources, and contaminant migration pathways (e.g., location of sites, aquifers, and surface water runoff drainage patterns). Field characterization techniques and sampling locations were selected in consultation with DSHE ECRD, USEPA Region III, and MDE. Laboratories utilized during RI activities at CCSA included:

Environmental Science and Engineering, Inc.
14220 Newberry Road
Gainesville, FL 32608

Ecology and Environment
368 Pleasant View Drive
Lancaster, NY 14086

GPL Laboratories, LLLP
7210A Corporate Court
Frederick, MD 21703

Quanterra Environmental Services
2800 George Washington Way
Richland, WA 99352

Table 1 lists major elements of the RI/FS sampling program, presenting information on the type and number of environmental samples collected at each site, parameters analyzed, and other field program elements, such as geophysical and soil gas surveys.

As shown in Table 1, media sampling (i.e., surface soil, sediment, surface water, groundwater and subsurface soil[1]) was conducted during three phases[2]:

- Phase I RI – Jacobs Engineering (1994-1995);
- Phase II ERA Sampling – EA Engineering (2003); and
- Phase III RI – General Physics Corporation (2004-2005).

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[1] Groundwater data from the JEG Phase I RI is not discussed in this report. Groundwater contamination within the WCCA is discussed in a separate RI report that was published in 2005 as a draft-final document (Weston, 2005). Groundwater contamination within the ECCA is being captured and treated at the Canal Creek Groundwater Treatment Plant, in accordance with the ROD signed in July 2000 (Weston, 2000a). Groundwater data from GPs Phase III RI was collected to assess the quality of the Surficial Aquifer and is discussed in Section 4.37.

[2] A portion of the Phase II RI was conducted at Three Sites in Canal Creek: EACC1A-A (WWII Railroad Yard & Maintenance Shop), EACC1A-B (G-Street Soils and Burn Residue Disposal Area), and EACC1D (DM Filling Plant). These sites are discussed in the *Phase II RI Report for IRP Sites 2, 6, and 46* (Shaw, 2003).

Table 1. Remedial Investigation Summary for the Kings Creek Industrial Area Sites

AEDB-R (DSERTS) NO. (AREA)*	SITE NAME	LOCATION	SITE HISTORY	PREVIOUS SAMPLING ACTIVITIES AND REMOVAL ACTIONS[1, 2]	PHASE III RI SAMPLING
EACC3A (5.88 acres)	Building E3330 Laboratory Toxic Waste Disposal Pits	Three pits located on eastern side of Building E3330, north of Beach Point Road	Disposal of laboratory wastes in pits from 1943 - late 1940s (including mustard, lewisite, chloropicrin, and contaminated laboratory equipment)	• Phase I RI – geophysical survey, 4 soil borings (11 subsurface samples), and 1 groundwater sample • ERA Sampling – four surface soil samples based on 25 XRF sample locations • No recent removal actions.	• 2 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 1 "Priority 2" boring with samples analyzed for full suite • 1 "Priority 1" groundwater sample (existing monitoring well) for select parameters
EACC3C (50.8 acres)	Building E32XX/E3100/3081 Medical Research Laboratories	Located along east side of Ricketts Point Rd, between the Family Housing Area and Building E3300	Constructed during WWII over the former Ft. Hoyle Training Site; Building E3100 built in 1960s as medical research laboratory; Building E3081 constructed in 1979	• Phase I RI – 8 geophysical surveys, 4 surface soil, 7 sediment, and 4 surface water samples • ERA Sampling – 3 sediment and 6 surface soil samples • A 275-gallon tank behind Building E3236 (HMF 91707), originally thought to contain laboratory waste[3], is an active sewage lift station for the 32XX area[4]; thus, could not be abandoned. • 2,000-gallon steel holding tank (HMF 91541) on the east side of Building E3222 was closed in 1989 and later removed in 2000[5,6].	• 12 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 5 "Priority 1" borings with samples analyzed for full suite (only 1 intended for HHRA, others expedited due to co-located DPTs) – 7 "Priority 2" borings with samples analyzed for select parameters • 5 co-located "Priority 1" DPT groundwater samples for select parameters (SB-39 was not sampled for groundwater because no water was encountered)
EACC3D (19.6 acres)	Building E3160 Complex	Located east of Building E3100 at the end of North Kings Creek Rd	Structures built during WWI; Building E3160 originally used as medical research physics	• Phase I RI – 3 surface soil and 1 sediment sample • ERA Sampling – 4 surface soils	• 1 "Priority 1" soil boring (2 samples per boring at 0-5ft and 5-10ft); both samples for full

* Site acreages vary slightly from the values presented in the *Work Plan for the Potential Source Definition Study (Phase III Remedial Investigation)* (GP, 2004). These new values reflect subtle changes in site boundaries that were made to ensure consistency between figures used in the various RI and risk assessment documents.

Table 1. Remedial Investigation Summary for the Kings Creek Industrial Area Sites

AEDB-R (DSERTS) NO. (AREA)*	SITE NAME	LOCATION	SITE HISTORY	PREVIOUS SAMPLING ACTIVITIES AND REMOVAL ACTIONS[1, 2]	PHASE III RI SAMPLING
			laboratory primarily for wound assessment	• Nearby abandoned buildings associated with the former Wound Ballistics Program (Buildings E3164, E3165, E3170A, E3176, and E3177) were removed in 1992[7].	suite analysis (for HHRA) • 2 "Priority 1" sediment samples (SD-27 was included in Sediment evaluation with EACC5B) • 1 "Priority 1" surface water sample
EACC3E (19.4 acres)	Building E3300 Laboratory Complex	Located along the east side of Ricketts Point Rd north of Beach Point Rd	Original facilities constructed during 1941 and 1942; Last of structures built in mid-1960s; Building E3300 built in 1965 as the "super toxic laboratory" for R&D related to chemical warfare	• Phase I RI – 1 surface soil, 2 sediment, and 2 surface water samples • ERA Sampling – none • The 285-gallon steel wastewater tank (HMF 91549) immediately adjacent to Building E3348 and steel inlet pipe were removed in 2000[5]. The surface soil collected during the RI was in the vicinity of this HMF[6].	• 4 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 3 "Priority 2" borings with samples analyzed for select parameters • 3 "Priority 1" surface soil samples for full suite • 1 "Priority 1" surface water sample for full suite • 1 "Priority 1" groundwater sample (existing monitoring well) for select parameters
EACC3F (14.8 acres)	Building E35XX Area	Located southeast of the intersection of Ricketts Point Rd and Beach Point Rd	Many buildings constructed during WWII era; contains a number of small laboratories and test/ surveillance chambers	• Phase I RI – 81 soil gas and 5 surface soil samples • ERA Sampling – none • No recent removal actions.	• 11 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 6 "Priority 1" borings with samples analyzed for full suite (only 1 intended for HHRA, others expedited due to co-located DPTs) – 5 "Priority 2" borings with samples analyzed for select parameters • 6 co-located "Priority 1" DPT groundwater samples for select parameters

Table 1. Remedial Investigation Summary for the Kings Creek Industrial Area Sites

AEDB-R (DSERTS) NO. (AREA)*	SITE NAME	LOCATION	SITE HISTORY	PREVIOUS SAMPLING ACTIVITIES AND REMOVAL ACTIONS[1, 2]	PHASE III RI SAMPLING
EACC3G (8.16 acres)	Building E360X, E361X, E362X Area	Located along the north side of Beach Point Rd, east of the Building E3330 Laboratory	Structures built after WWII; used for offices, laboratories, and material storage	• Phase I RI – 7 surface soil, 3 sediment, and 1 surface water sample • ERA Sampling – 49 soil locations for XRF only • No recent removal actions.	• 4 geophysical surveys (total approximately 0.2 acres) • 4 "Priority 1" surface soil samples for full suite • 6 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 5 "Priority 2" borings with samples analyzed for select parameters • 1 "Priority 1" sediment/surface water sample for full suite
EACC3I (7.67 acres)	Building 3570 Assembly Plant	Located along the south side of Beach Point Rd, adjacent to the Building E3560 Test Chamber Complex	Constructed in 1953 as a munitions assembly plant; used for production of bomb clusters and for vehicle contamination testing; Building E3570 used as a laboratory; also used for machining and assembly-type work over recent years	• Phase I RI – 7 soil borings (19 subsurface soil samples) and 1 surface soil sample • ERA Sampling – none • No recent removal actions.	• 1 geophysical survey (approximately 0.5 acres) • 7 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 7 "Priority 1" borings with samples analyzed for full suite (only 1 intended for HHRA, others expedited due to co-located DPTs) • 7 co-located "Priority 1" DPT groundwater samples for select parameters • 3 "Priority 1" surface soil samples for full suite
EACC3J (3.64 acres)	Building E3580 Pyrotechnic Loading Facility	Located southwest of the intersection of Beach Point Rd and 57th St	Most structures built in 1951 and 1952; used since 1952 for R&D of pyrotechnic mixtures	• Phase I RI – 2 soil borings (4 subsurface soil samples) and 1 surface soil sample • ERA Sampling – none • Removal of PCB-contaminated soil in 1992[8] and further assessment of drainage swales surrounding	• 8 "Priority 2" surface soil samples for select parameters • 8 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA)

Table 1. Remedial Investigation Summary for the Kings Creek Industrial Area Sites

AEDB-R (DSERTS) NO. (AREA)*	SITE NAME	LOCATION	SITE HISTORY	PREVIOUS SAMPLING ACTIVITIES AND REMOVAL ACTIONS[1, 2]	PHASE III RI SAMPLING
				Building E3580 (no soil removed, because the lab results were below action levels)[9].	– 7 "Priority 2" borings with samples analyzed for select parameters • 1 "Priority 1" groundwater sample (existing monitoring well) for select parameters • 7 co-located "Priority 2" DPT groundwater samples for select parameters
EACC3K-A (4.55 acres)	Building E3700 Complex -- includes Buildings E3724, E3726, and E3728	Located north of the intersection of Beach Point Rd and 57th St	Structures constructed in 1942 and 1943 for use as new pilot plant facilities; support structures built in 1945; used for experimental filling rather than process work	• Phase I RI – 5 geophysical surveys, 6 surface soil and 2 sediment samples • ERA Sampling – 6 surface soil samples • The 500-gallon underground wastewater tank (HMF 91563) located inside Building E3728 was filled with flowable fill by ERDEC[4] (no date provided).	• 6 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 2 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 4 "Priority 2" borings with samples analyzed for select parameters
EACC3K-B (46.8 acres)	B-Field Kings Creek Dump Site	Located southwest of Kings Creek, north and east of Building E3700	Dumpsite for demolition debris, chemical materiel, and miscellaneous items	• Phase I RI – none • ERA Sampling – 3 surface soil and 2 surface water/sediment • No recent removal actions.	• 5 "Priority 2" soil borings (2 samples per boring at 0-5ft and 5-10ft); analyzed for full suite • 3 "Priority 1" surface soil samples for full suite • 2 "Priority 1" sediment/surface water samples for full suite • 1 "Priority 1" groundwater sample (existing monitoring well) for select parameters • 2 "Priority 3" test pits (at least 2 samples per pit for full suite) • 1 geophysical survey (approximately 1.2 acres)

Table 1. Remedial Investigation Summary for the Kings Creek Industrial Area Sites

AEDB-R (DSERTS) NO. (AREA)*	SITE NAME	LOCATION	SITE HISTORY	PREVIOUS SAMPLING ACTIVITIES AND REMOVAL ACTIONS[1, 2]	PHASE III RI SAMPLING
EACC3L (4.41 acres)	Building E3640 Process Laboratory	Located on the north side of Beach Point Rd, northeast of Building E3570	Constructed in 1951/1952 and used as a process laboratory from 1952 through 1978; also used for research involving chemical agents; removal actions to fill onsite sumps completed in 1995 (complex is scheduled for demolition in FY07)	• Phase I RI – 25 soil borings (29 subsurface soil samples), 4 groundwater, 15 surface soil, 7 sediment, and 2 surface water samples • ERA Sampling – 18 surface soil samples • Sump abandonment [10] and removal action (including removal of pipeline and 310 tons of contaminated soil) conducted in 1995[11].	• 4 soil borings (2 samples per boring at 0-5ft and 5-10ft) – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 3 "Priority 2" borings with samples analyzed for full suite • 4 "Priority 1" groundwater samples (existing monitoring wells) for select parameters • 2 "Priority 1" surface soil samples for full suite
EACC3M-A (8.80 acres)	Wastewater Treatment Plant	Located at the eastern end of Beach Point Rd, southwest of the Beach Point peninsula	Original facility constructed in 1941/1942; upgraded twice in 1960s and 1980s -- still in operation	• Phase I RI – 10 soil borings (26 subsurface soil samples), 3 groundwater, 1 surface soil, and 3 sediment samples • ERA Sampling – none • No recent removal actions.	• 1 geophysical survey (approximately 2.1 acres) • 4 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 3 "Priority 2" borings with samples analyzed for select parameters • 1 "Priority 1" groundwater sample (existing monitoring well) for select parameters
EACC3N (11.92 acres)	Beach Point Test Site	Located at the eastern end of Beach Point Rd and includes the upper peninsula, areas south of Beach Point, and southeast of the APG-EA WWTP	Used as a testing site for 4.2-inch mortar rounds (1940s) and pyrotechnic devices and smoke generators (1945-1970)	• Phase I RI – 2 soil borings (4 subsurface samples), 8 surface soil, and 2 sediment samples • ERA Sampling – 6 soil locations for XRF only, 4 surface soil, and 3 sediment samples • No recent removal actions.	• GP Sampling - none

Table 1. Remedial Investigation Summary for the Kings Creek Industrial Area Sites

AEDB-R (DSERTS) NO. (AREA)*	SITE NAME	LOCATION	SITE HISTORY	PREVIOUS SAMPLING ACTIVITIES AND REMOVAL ACTIONS[1, 2]	PHASE III RI SAMPLING
EACC3O (54.19 acres)	B-Field Range	Located along a trail southeast of Building E3580 and Beach Point Rd	Used as an impact area for mortar and artillery testing from A-Field during the 1920s; may also been site of GA storage during late 1940s	• Phase I RI – none • ERA Sampling – 4 surface soil samples • No recent removal actions.	• 2 geophysical surveys (total approximately 6.5 acres) • 4 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 3 "Priority 2" borings with samples analyzed for full suite • 2 "Priority 1" groundwater samples (existing monitoring wells) for select parameters
EACC3P (8.81 acres)	Mosquito Test Grid Area	Located south of Building E2100	82 ponds used in late 1960s for development of pesticides for mosquito control	• Phase I RI – none • ERA Sampling – none • No recent removal actions.	• 8 soil borings (2 samples per boring at 0-5ft and 5-10ft): – 1 "Priority 1" boring with samples analyzed for full suite (for HHRA) – 7 "Priority 2" borings with samples analyzed for select parameters • 8 "Priority 1" surface soil samples (for ERA) for full suite

NOTE: DSERTS Sites EACC1A-A (WWII Railroad Yard), EACC1A-B (G-Street Salvage Yard), EACC1D (DM Filling Plant), EACC1H-E (Building 103 Dump), EACC1L-A (Building 503 Smoke Mixture Burning Sites), EACC2F (Former Building 99 Experimental Filling Plant), EACC3M-B (Decon/Detox Incinerator), EACC4A-A (East Area Canal Creek Aquifer), EACC4A-B (West Area Canal Creek Aquifer), EACC5A (Canal Creek Bed Sediment Source Area), EACC5B (Kings Creek Sediment Pesticide Source Area), EACC6 (HMF/UST Removal/Closure), and EACC7 (Unexploded Ordnance/Chemical Warfare Materiel) are not included in the scope of this task (i.e., either addressed by previous action or being evaluated under a separate RI/FS).

Table 1. Remedial Investigation Summary for the Kings Creek Industrial Area Sites

Acronyms and Abbreviations:

AEDB-R	Army Environmental Database – Restoration	ERDEC	Edgewood Research, Development, & Engineering Center	UST	Underground Storage Tank
DPT	Direct Push Technology	ft	feet	WWI	World War I
DSERTS	Defense Site Environmental Restoration Tracking System	HMF	Hazardous Material Facility	WWII	World War II
ERA	Ecological Risk Assessment	PCB	Polychlorinated Biphenyl	WWTP	Wastewater Treatment Plant
		R&D	Research and Development	XRF	X-Ray Fluorescence
		RI	Remedial Investigation		

References:

(1) Jacobs Engineering Group, Inc. (JEG). 1995b. *IRP Site Characterization Strategies Report*. Edgewood Area, APG, MD: US Army DSHE. October 1995.

(2) EA Engineering, Inc. 2004a. Electronic mail communication between Ms. Savannah Cutter (EA) and Ms. Jennifer Harris (GP) dated 23 February 2004.

(3) Argonne National Laboratory. 1995. *Contamination Source Review for Building E3236*. Edgewood Area, APG, MD: US Army. September 1995.

(4) WESTON. 1999. *Canal Creek Study Area, Engineering Evaluation/Cost Analysis for Hazardous Material Facilities*. Edgewood Area, APG, MD: US Army Directorate of Safety, Health and Environment (DSHE). June 1999.

(5) Roy F. Weston, Inc. (WESTON). 2000b. *Final Report for the Canal Creek Study Area Hazardous Material Facilities Non-Time Critical Removal Action*. Edgewood Area, APG, MD: US Army Directorate of Safety, Health and Environment (DSHE). May 2000.

(6) WESTON. 1998. *Canal Creek Study Area, Hazardous Materials Facilities (HMF) Characterization, Field Sampling and Analysis Plan*. Edgewood Area, APG, MD: US Army DSHE. April 1998.

(7) WESTON. 1992. *Removal of Contaminated Buildings Associated with the Former Wound Ballistics Program at Edgewood Area, Aberdeen Proving Ground, MD*. Baltimore, MD: US Army Corps of Engineers Baltimore District. May 1992.

(8) R&R International, Inc. 1992. *Interim Remediation of PCB Contaminated Soil, Building E3580 Site (Pyrotechnic Loading Facility), Edgewood Area, APG, MD*. Baltimore, MD: US Army Corps of Engineers Baltimore District. June 1992.

(9) R&R International, Inc. 1993. *Final Technical Report: Corrective Action at the Building E3580 Drainage Swales, Edgewood Area, APG, MD*. Baltimore, MD: US Army Corps of Engineers Baltimore District. April 1993.

(10) R&R International, Inc. 1995. *Sump Abandonment at the Process Laboratory Facility at Building 3640*. Baltimore, MD: US Army Corps of Engineers Baltimore District. March 1995.

(11) Foster Wheeler. 1996. *Final Technical Report, Building E-3640 Complex Removal Action*. Baltimore, MD: US Army Corps of Engineers Baltimore District. February 1996.

To expedite the closeout of the first ten NFA sites in 2005, the Phase III RI was further broken down into three segments:

- "Priority 1" Sampling – soil borings, surface soil, sediment, surface water, and groundwater;
- "Priority 2" Sampling – additional soil borings for characterization of nature and extent in known areas of contamination; and,
- "Priority 3" Sampling – test digs in areas with suspected buried waste.

Geophysical surveys were also conducted during the "Priority 1" mobilization at select sites (i.e., those recommended for further evaluation by JEG in their 1995 *IRP Site Characterization Strategies Report* or sites with previous survey data that had not been reduced or analyzed by the previous contractor).

2.1 Surface Features Investigation

The RI team performed field reconnaissance at various CCSA sites to support development of the CCSA RI Work Plans and to verify interpretations of historical aerial photographs. Field surveys involved visually observing manmade and natural features at the CCSA including conditions at suspect features (e.g. mounds, physically disturbed or stained soil areas, and areas barren of vegetations). Visual examinations also verified site geology, physical features, and land use. Field reconnaissance data facilitated the finalization of Phase III RI sampling locations.

2.2 UXO Avoidance and Clearance for Intrusive Activities

Due to the potential for encountering unexploded ordnance (UXO) throughout APG-EA, UXO surveys of work areas were required throughout CCSA. UXO survey teams from APG-approved explosive ordnance disposal (EOD) contractors (e.g., Human Factors Applications, Inc. and USA Environmental, Inc.) implemented an ordnance avoidance program during the collection of all intrusive environmental samples.

Prior to mobilizing equipment, access routes and work locations for drilling and Direct Push Technology (DPT) activities were swept and cleared of all near-surface UXO following standard APG-approved policies. Before conducting subsurface soil and DPT sampling, the UXO survey teams conducted visual inspections; and magnetically swept, flagged, and cleared all metallic objects to a depth of 12 ft using "down-the-borehole" techniques.

2.3 Chemical Warfare Agent Screening

During the first phase of the RI, JEG collected a sample from each soil/sediment location for chemical warfare agent screening in accordance with APG Standard Operating Procedure (SOP)

#035. These soil samples were submitted to the Chemical Transfer Facility for initial headspace analysis of Mustard (HD), Sarin (GB), Soman (GD), and o-ethyl s-[2-(diisoproylamino)ethyl] methylphosphonothiolate (VX). After the samples cleared headspace analysis, the samples were transported to the on-post SciTech Services, Inc. laboratory for further low-level analysis of HD, GB, GD, and VX. All samples tested negative for these chemical warfare agents. Based on these results, chemical warfare agent screening was not required during the later phases of the RI at the KCIA sites.

2.4 Geophysical Investigations

In 2004, electromagnetic (EM)-61 and EM-31 equipment was used by Enviroscan, Inc. to detect and delineate targets within five of the fifteen KCIA sites (Table 2). Four surveys were completed and designated A through D at EACC3G. Two surveys were completed and designated A and B at EACC3O. One survey was completed and designated EACC3K at site EACC3K-B. The geophysical investigations were conducted in a manner consistent with SOP #018 (USACE, 1999). Location control during the surveys was provided by Differential Global Positioning System (GPS) to ensure Geographic Information System (GIS)-compatible mapping. However, some data were lost due to poor GPS coverage (particularly in wooded areas). Data were digitally recorded in the instrument's hard-wire memory, and periodically transferred in the field onto a portable computer. The investigation results are summarized in individual site discussions in Section 4.0. A copy of the final geophysical survey report is provided in Appendix A.

EM Induction

The instrument used in EM surveys consists of an electromagnetic transmitter coil that induces an electric current in the subsurface, creating a secondary electromagnetic field that is measured by a receiver coil. The secondary magnetic field measures the conductivity of the terrain and the relative concentration of metallic material in the subsurface.

The sensitivity of EM instruments is greatest at a depth of approximately five ft; however, some contribution can be measured from materials at depths up to approximately 25 ft below ground surface (bgs) (Enviroscan, 2004). Both the EM-61 and EM-31 instruments were used at the CCSA sites. The EM-61 was used to perform mapping of subsurface metallic masses while the EM-31 was used to perform mapping of subsurface metallic and non-metallic electrically conductive masses. The EM-31 is sensitive to buried metal, but also sensitive to minor changes in the electrical conductivity of subsurface materials in the absence of metal (i.e., due to non-metallic debris and/or anomalous ionic content of any soil moisture). In the vertical dipole mode, EM-31 instruments are less sensitive to materials at the ground surface. However, excessive amounts of surface metal limit the ability to conduct a complete, reliable, and effective EM-31 survey.

Table 2.
Geophysical Method Summary for the KCIA Sites, Canal Creek Study Area

SITE NO.	IRP Site #	Survey Targets	Geophysical Methods Employed	Survey Results and Interpretations
EACC3G	36	Conducted near Buildings E3615, E3619, and E3623 to investigate the presence of USTs or sumps.	EM-61 for structures and USTs.	Anomalies detected with characteristics commonly associated with USTs. One point target detected and one cluster of anomalies that may represent debris.
EACC3I	38	Conducted east of Building E3570 in the area where surficial debris was observed.	EM-61 for structures, EM-31 for non-metallic debris and possible conductive contaminated soil.	One cluster of anomalies detected in southeast corner of survey that may represent debris.
EACC3K	40	Conducted to determine whether buried materials are present east of Building E3724 (B-Field Kings Creek Dump Site)	EM-61 for structures, EM-31 for non-metallic debris and possible conductive contaminated soil.	Anomalies that may represent suspected utility and metallic surficial debris.
EACC3O-A	49	Conducted to determine whether buried materials are present east of Building E3724 (B-Field Kings Creek Dump Site)	EM-61 for structures, EM-31 for non-metallic debris and possible conductive contaminated soil.	Anomalies that may represent suspected utilities and debris.
EACC3O-B	49			Anomalies representing suspected debris pits
EACC3M	42	Conducted to determine whether buried materials are present in a trench located within the northern portion of the site.	EM-61 for structures, EM-31 for non-metallic debris and possible conductive contaminated soil.	No anomalies detected representing structures.

2.5 Soil Investigations

Soil sampling was conducted throughout CCSA during all three phases of the RI. Surface soil was collected at a depth of 0 to 0.5 ft below the vegetative mat. Surface soil investigations were performed to assess the surface transport exposure pathways from known or potential sources. Subsurface soil samples were collected from 0 to 10 ft bgs. All soil sampling was conducted in accordance with APG SOP #025.

Phase I JEG RI samples were analyzed for full suite chemistry, including Target Compound List (TCL) VOCs, TCL SVOCs, pesticides/polychlorinated biphenyls (PCBs), Target Analyte List (TAL) metals, explosives, chemical warfare agent degradation products (CADPs), and gross alpha/gross beta. Quality assurance/quality control (QA/QC) issues for the JEG sampling efforts are discussed in the *RI/FS Final Field Sampling Plan* (JEG, 1994) and *RI/FS Final Work Plan* (JEG, 1995a).

Additional surface soil samples were collected in support of the ERA in December 2003 (discussed in this report as Phase II of the RI). These samples were analyzed for select parameters including: TCL VOCs, TCL SVOCs, TAL metals, pesticides, PCBs, explosives, and CADPs. Additional tests including metals bioavailability [using the Sequential Extraction Procedure (SEP)], terrestrial plant and earthworm toxicity tests, and terrestrial and plant bioaccumulation tests were also conducted. EA field activities were conducted in accordance with the *Work Plan for Canal Creek Area DSERTS Sites at U.S. Army Aberdeen Proving Ground, Maryland* (EA, 2004b) and *Quality Assurance Project Plan for the Investigation of Sediments, Surface Soil, and Surface Waters at U.S. Army Aberdeen Proving Ground* (EA, 2003).

As mentioned previously, the Phase III RI was broken down into three segments:

- "Priority 1" Sampling – soil borings, surface soil, sediment, surface water, and groundwater;
- "Priority 2" Sampling – additional soil borings for characterization of nature and extent in known areas of contamination; and,
- "Priority 3" Sampling – test digs in areas with suspected buried waste.

Surface and subsurface soil samples collected during the Phase III Priority 1 sampling effort were analyzed for full suite chemistry (including TCL VOCs, TCL SVOCs, pesticides/PCBs, TAL metals, explosives, CADPs, and gross alpha/gross beta). Priority 2 and 3 samples were analyzed for select parameters, depending on the nature of contamination or suspected waste. Analytical methods and QA/QC measures used during all Phase III sampling efforts are described in detail in the *Quality Assurance Project Plan for the Potential Source Definition Study (Phase III Remedial Investigation)* (GP, 2004c).

The results of all three phases of soil sampling are discussed in Section 4.0.

2.6 Surface Water and Sediment Investigations

During Phase III, sediment and surface water samples were collected and analyzed for full suite chemistry to assess the nature and extent of contamination in drainage areas within the CCSA, in accordance with APG SOP #007 (surface water) and #021 (sediment). The following surface water quality parameters were measured in the field: temperature, pH, conductivity, salinity, dissolved oxygen, redox potential (oxidation-reduction potential), and turbidity. Select samples were later collected and analyzed for perchlorate, in conjunction with the CCSA-wide perchlorate sampling program. The results of sediment and surface water sampling are discussed in Section 4.0.

2.7 Test Dig Investigations

One test dig was conducted within the fifteen KCIA sites at EACC3K-B. The results of the test digs conducted within the other three regions of CCSA are discussed in Volumes I, II, and III of the Draft RI Report and will be included in the Final RI Report.

UXO survey teams from APG-approved EOD contractors implemented an ordnance avoidance program during the collection of all intrusive environmental samples. Test digs were conducted via hand excavation. The depths of the hand excavations were limited to 2 ft (i.e., limits of visual contamination). Magnetic detectors also were used to verify that metallic objects were not buried below an observation of visible waste material. Each test dig was backfilled with the excavated soil.

Eleven test digs were conducted at site EACC3K-B on April 12, 2005 at two separate locations, identified as TD-07 and TD-08. Six test digs were conducted at TD-07 and five test digs were conducted at TD-08. Holes TD-07A through TD-07F were advanced to the base of the metallic contacts and burn ash (a maximum of two feet). TD-07B was excavated to a depth of five feet; however, the base of the burn ash was never found. Holes TD-08A through TD-08C were conducted one foot below the debris found at the surface. Holes TD-08D through TD-08E were completed as 2 ft by 2 ft by 2 ft holes. Four soil samples were collected at locations TD-07A (2 ft bgs), TD-07B (4 ft bgs), TD-08A (1 ft bgs), and TD-08B (1 ft bgs) for full-suite chemical analysis. Debris encountered at TD-07 included two 55-gallon drum at the surface, burn ash, small metal fragments, a 6-inch metal bracket, various rusted metal pieces, a 5-gallon metal bucket, a 10-ft long 1-inch pipe, and large concrete pieces. Debris encountered at TD-08 included a 20-gallon drum, 4-ft long sheet metal, and a 4-ft long 1-inch pipe.

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3.0 PHYSICAL CHARACTERISTICS

This section discusses the physical characteristics based on the results of physical investigations and reference documents for the CCSA and APG. This section summarizes meteorology, surface water drainage, regional and localized geology, hydrogeology, and land use for the CCSA.

3.1 Meteorology

APG-EA experiences a modified temperate climate. The Installation's proximity to the Chesapeake Bay, the Atlantic Ocean, and Appalachian Mountains effects the general atmospheric circulation of the area. These atmospheric effects prevent APG from having a typical mid-latitude temperate climate. Winters are humid and generally milder than in the inland areas, and summers are hot and humid with frequent thunderstorms. Average annual air temperature is approximately 54°F. Average daily temperatures generally range from 34°F in the winter to 75°F in the summer. Temperatures commonly exceed 90°F during the summer, and are accompanied by high humidity yielding a subtropical climate. The average annual relative humidity is 74 percent. The warmest period of the year is during July and August, and the coldest period of the year is during January and February. Average annual precipitation is approximately 45 inches. The distribution of monthly precipitation is fairly uniform throughout the year; the maximum precipitation usually occurs in late winter or spring, and the minimum precipitation usually occurs in late summer or fall. Prevailing winds are from the west to northwest in the fall and winter, and from the south to southwest in the spring and summer. Average annual wind velocity ranges from 6 to 10 miles per hour, but can reach over 50 miles per hour and higher during severe storms (Atmospheric Sciences Laboratory, 1985).

3.2 Surface Water Drainage

The CCSA was named after Canal Creek, which drains an area of over 3,000 acres. The East and West Branches of Canal Creek flow southward to the Gunpowder River. In the eastern portion of CCSA, surface water drains into Lauderick Creek and Kings Creek. Both of these creeks drain into the Bush River (USGS, 1996). The West Branch of Canal Creek is surrounded by wetlands (with some fill areas); whereas, the East Branch has been channelized by fill areas on either side of the creek. Smaller tributaries at various locations in the CCSA discharge into these streams, and treated groundwater from the Canal Creek Groundwater Treatment Plant discharges into the East Branch of Canal Creek. The land surface is characterized by low-rolling terrain, with elevation ranging from sea level along the Gunpowder River shoreline and the lower reaches of the West Branch of Canal Creek to approximately 40 ft above msl at G-Street.

3.3 Geology

Harford County spans two physiographic provinces, the Piedmont and Atlantic Coastal Plain. The Piedmont contains crystalline basement rocks of Precambrian (more than 570 million years old) and early Paleozoic age. In the Atlantic Coastal Plain, unconsolidated sediment consisting of clay, silt, sand, and gravel of Cretaceous, Pleistocene, and Holocene age (144 million years old to recent) unconformably overlie the crystalline rocks. The division between these provinces is known as the Fall Line. APG lies southeast of the Fall Line. Sediment beneath APG is part of the thick sequence of unconsolidated sediment that forms the Atlantic Coastal Plain. Structurally, this sediment fills the Salisbury Embayment; a deep-seated basement structure that is perpendicular to the Atlantic coast. Sloping to the southeast at approximately 25 to 65 ft per mile, this embayment extends beneath the Delmarva Peninsula and into the Atlantic Ocean. Table 3 presents the generalized stratigraphy of the Atlantic Coastal Plain in Harford County, Maryland.

The CCSA lies on unconsolidated sediment of the Atlantic Coastal Plain, which was deposited by the actions of streams, rivers, and seas, and forms a wedge-shaped body that thickens southeastward. This sediment crops out at APG and comprises three stratigraphic units. From oldest to youngest, the units are the Potomac Group of Cretaceous age (65 to 145 million years old), the Talbot Formation of Pleistocene age (approximately 10,000 years old to 2 million years old), and Holocene (i.e., less than 10,000 years old) alluvium. A major unconformity occurs between the Pleistocene and Cretaceous sediments. Missing from the geologic record are sediments deposited during the Upper Cretaceous and Lower Neogene Periods (i.e., from 65 to 2 million years old). Removal of these sediments from the APG area was probably due to erosion by earlier Susquehanna River systems during the Lower Neogene or Early Pleistocene Periods. The Potomac Group is undifferentiated in Harford County and consists of sand and gravel interbedded with multicolored clay. The Talbot Formation is extremely variable because of the changing thickness of clay and sand facies and the presence of clay interbeds in gravelly sand facies. Alluvial deposits occur adjacent to and within drainage ways and topographic lows (Maryland Geological Survey, 1968a, 1968b, 1969, 1993; USACE, Waterways Experiment Station, 1997; American Geological Institute, 2004).

In the CCSA, Holocene alluvium is found along the two branches of Canal Creek, and is presumed to be in contact with Cretaceous units because the Pleistocene Talbot Formation has eroded in these areas. The regional dip of the formations, their projected thickness, and the vertical sequence of facies suggest the Talbot Formation sand and gravel facies is equivalent to the upper horizons of the CCA. The Upper Confining Unit above the CCA is equivalent to the silty-clay facies of the Talbot Formation (JEG, 1995b). Section 3.4 discusses the CCSA hydrogeology as it relates to the RI sites.

Table 3. Generalized Stratigraphy of the Coastal Plain in Harford County, Maryland

System	Series	Group	Formation	Generalized Stratigraphy	Water-Bearing Properties
Neogene	Holocene (Recent)		Alluvium	Clay, sand, silt, and gravel	Could yield large quantities of water where recharge can be induced from nearby streams
	Pleistocene		Talbot	Fine to medium silty-sand with mixtures of fine gravel and lenses of silt and clay; localized areas of marine silty clay unit	Water table aquifer where composed of coarse grained water-bearing materials, as in Aberdeen and Havre de Grace areas; yields up to 500 gallons per minute
Cretaceous	Lower Cretaceous	Potomac	Patapsco	Fine to medium, sand, silt, and clay	Yields some water to domestic wells in Harford County
			Arundel	Silty-clay to clayey-silt with lenses of organic silty-clay and traces of lignite and ironstone nodules	Not a water-bearing formation, except where penetrated by a few wells in outcrop area
			Patuxent	Fine to medium sands and gravels intercalated with silt and clay lenses	Source of water for numerous domestic and small commercial groundwater supplies along US Highway 40; thickens rapidly toward southeast and becomes an excellent aquifer yielding up to 1,000 gallons per minute
Pre-Cambrian	Glenarm		Wissahickon and others	Bedrock	Not a water-bearing formation.

Source: Modified from US Army Corps of Engineers, Waterways Experiment Station, 1997.

Note: The Tertiary and the Quaternary have been eliminated from the most recent International Stratigraphic Charts. The Quaternary was formerly considered to be made up of the Holocene and the Pleistocene. The Paleogene and older Neogene were defined as the Tertiary (American Geological Institute, 2004).

3.4 Hydrogeology

A generalized hydrogeologic cross section of the sedimentary units underlying the CCSA, developed by the USGS, identifies three distinguishable sand aquifers separated by clay confining units (Figure 8). The Upper Confining Unit truncates the discontinuous Surficial (Water Table) Aquifer and the CCA lies below the Upper Confining Unit. Near the West Branch of Canal Creek, the CCA is unconfined where it crops out to the north and west. In the proximity of the East Branch of Canal Creek, the CCA appears to be in direct, hydrologic connection with the surface in the region denoted as a paleochannel, where the Upper Confining Unit is truncated or thinned. This vertical sediment sequence enables vertical movement of groundwater. The Surficial Aquifer in the region of the paleochannel appears to be directly connected with the CCA, representing a potential pathway for vertical migration of contamination. Further east the Surficial Aquifer crops out near existing estuarine waterways such as Kings Creek, and generally occurs as thin veneer of permeable sediments up to 35 ft thick. The continuous, Lower Confining Unit, lies beneath the CCA. The less permeable, Lower Confining Unit contains a larger percentage of clay than the Upper Confining Unit. The Lower Confined Aquifer lies beneath the Lower Confining Unit and has not been impacted by CCSA activities (USGS, 1989; JEG, 1995b).

Groundwater flow in the CCA is complex. Groundwater in the western portions of the CCSA flows into the West Branch of Canal Creek, while groundwater in the eastern portions of the CCSA flows to the southeast along the regional gradient. The groundwater divide between the westward and eastward flowing portions of the CCA traverses from the intersection of Hoadley and Magnolia Roads and continues southward to the east of the Hoadley Road. The exact location of the groundwater divide is influenced by seasonal variations in groundwater recharge and extraction (Weston, 2002). East of the East Branch of Canal Creek, the potentiometric surface is unaffected by surface water, and groundwater moves in the confined regional system. In the Kings Creek area, groundwater flow within the CCA is to the southeast.

Interpretations of the three aquifers and confining units within the CCSA have been developed by the contractor conducting the WCCA groundwater RI/FS. Rather than re-interpret their cross sections, Figures 2-2 through 2-6 from the draft final *RI for West Canal Creek Aquifer and Building E-5188* (Weston, 2005) have been provided for reference in Appendix B. Weston Figure 2-2 expands on the initial generalized cross section developed by the USGS, illustrating how the upper confining unit outcrops in the upland and lowland areas of WCCA. The three additional cross sections run west to east (A'-A) and north to southwest (B'-B) in the upland area and west to east across the West Branch of Canal Creek (C'-C). For additional details, please refer directly to the *RI for West Canal Creek Aquifer and Building E-5188* (Weston, 2005) or the *Plume Delineation Study Report – Canal Creek Aquifer* (Weston, 2002).

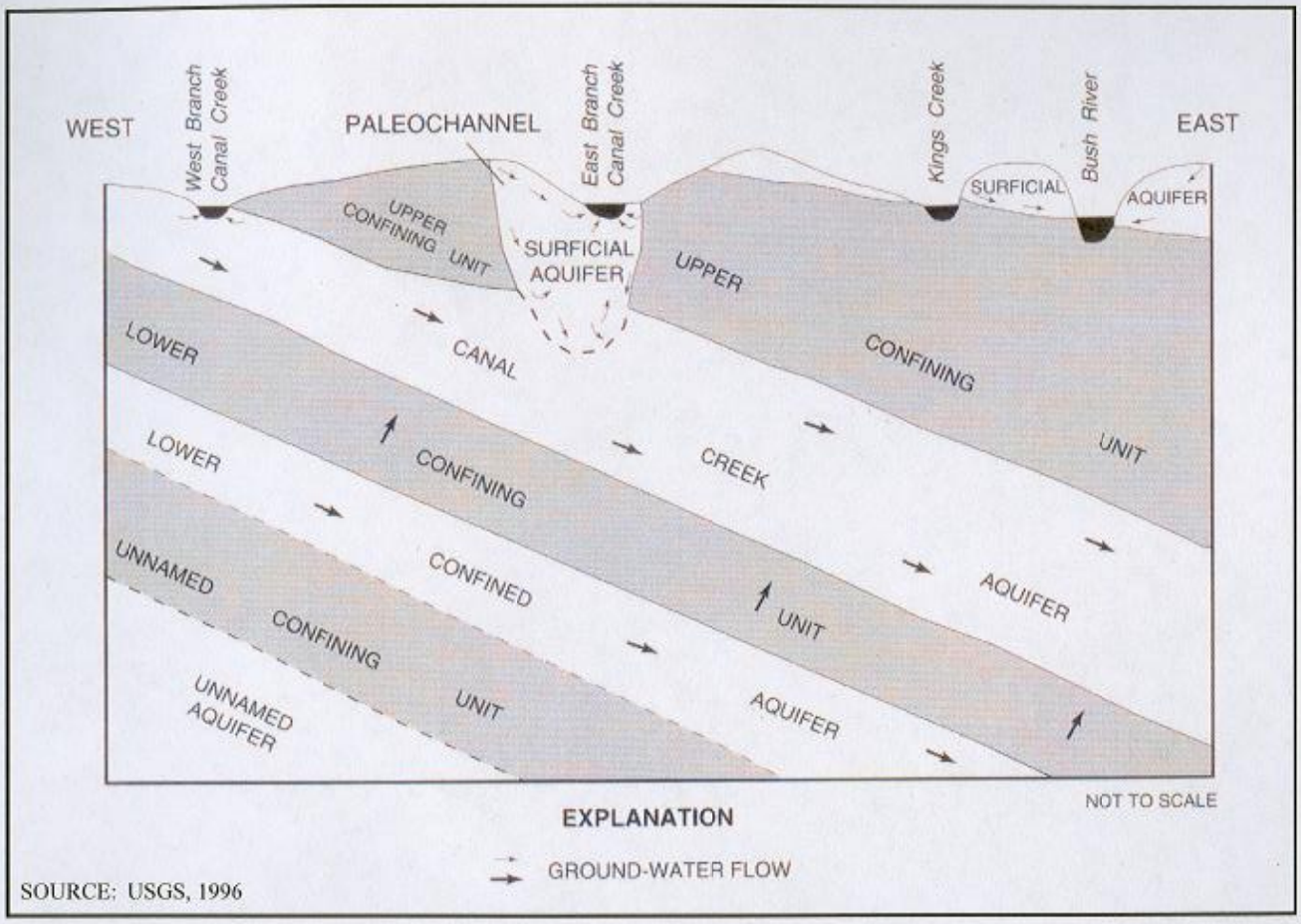

Figure 8. Generalized Hydrogeologic Cross Section

Based on hydraulic parameters under both Federal and State aquifer classifications, the CCA qualifies as a potential source of drinking water[3]. The encountered shallow, water-bearing units have not been used for a water supply and are not considered a potential source of drinking water.

3.5 Land Use and Demography

According to the *APG Land Use Assessment* (USACE and Michael Baker Corporation, 1998), current land use within the CCSA includes: research and development (R&D), supply/storage, open space, outdoor recreation, administration, airfield, and industrial. Buildings are used for warehousing, as offices, and for research and development activities. Several buildings within CCSA were also used historically for pilot-scale filling of chemical ordnance. With the exception of Weide Army Airfield (which may be subdivided into research and development, airfield, and open space), future land use within the CCSA is not expected to change substantially.

The closest residential housing for military personnel and their dependents is located on Clearview Drive, approximately 1,000 ft west of the northwestern corner of site EACC3P (i.e., northernmost site in KCIA). Off-post residential housing lies approximately 7,000 ft north of this point. The APG-EA work force numbers approximately 12,000 personnel.

[3] In 1942, several wells were drilled into the CCA to supply water to the Army industrial facilities. Later in 1968, these wells were converted for use as a standby water source during water shortages. However, these wells were shut down in 1984 at the direction of MDE due to contamination in the water supply. The six production wells were abandoned in 1995 (Weston, 2000a).

4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents analytical data generated from sampling and analysis of environmental media within the CCSA RI sites. Analytical results and data interpretations were used to determine the presence and impact of contamination. Section 4.1 presents the analysis approach used to compare the results to established RI comparison criteria for determining environmental impacts. Sections 4.2 through 4.7, which discussed the six sites within the MIA-NW region, were published in Volume I of the RI in April 2006 (draft). Sections 4.8 through 4.15, which discussed the eight sites within the MIA-SW region, were published in Volume II of the RI in August 2006 (draft). Sections 4.16 through 4.21, which discussed the six sites within the MIA-E region, were published in Volume III of the RI in September 2006 (working draft). To facilitate the review process, these sections have not been repeated in this document. All four volumes of the RI will eventually be published as one large final document. Sections 4.22 through 4.36, presented in this volume, summarize the results of sampling conducted at the fifteen KCIA sites.

Sediment and surface water samples (e.g., SW/SD-27 and SW/SD-30) associated with Kings Creek marsh will be addressed separately under the risk assessment for site EACC5B.

4.1 Approach to Analysis of Sampling Results

This section discusses the approach used for evaluating sample results for contamination assessments of the sites. The data analysis process in this section involves selecting established RI comparison criteria to identify significant contaminant concentrations, determining instances when exceptions to this approach are necessary, and screening data based on usability and blank contamination.

4.1.1 Selection of RI Comparison Criteria

Analytes detected in environmental media are compared to various criteria depending on the type of contaminant and the media being investigated. Sections 4.22 through 4.37 report all analytes present in media above the selected RI comparison criteria. The intent of presenting detected compounds above RI comparison criteria is to determine environmental impacts, assess contaminant sources, and evaluate contaminant migration. The Risk Assessment Summary (Section 6) focuses on two separate evaluations of the RI analytical results based on the potential for human health and ecological risks. Therefore, the RI comparison criteria outlined in this section may differ slightly from the risk assessment selections for identified contaminants of potential concern (COPCs).

Analytes in soil (and sediment re-classified as "hydric soil") were compared to industrial soil Risk-Based Concentrations (RBCs) as taken from the USEPA Region III's RBC Table (USEPA

Region III, 2006), because current and future land-use within the KCIA sites is industrial. The USEPA Region III Biological Technical Assistance Group (BTAG) requested that soil concentrations also be screened versus new Ecological Soil Screening Levels (EcoSSLs) (USEPA, 2003b - 2006b). In the absence of EcoSSLs, the 1995 BTAG soil screening values were used (USEPA, 1995b).

Analytes in surface water were compared to BTAG freshwater screening benchmarks (http://www.epa.gov/ reg3hwmd/risk/eco/index.htm). Many of these values have been derived from Federal Ambient Water Quality Criteria (FAWQC). Analytes in sediment were also compared to BTAG freshwater sediment screening benchmarks (http://www.epa.gov/reg3hwmd/risk/eco/index.htm).

If RBCs or BTAG screening values were not available for an analyte in surface water, sediment, or soil, then comparison was made to the 95% Upper Predictive Limit (UPL) calculated from the APG reference dataset (discussed in Appendix C). This dataset includes results from the *APG Reference Sampling and Analysis Program Soil, Sediment, and Surface Water Reference Data Report* [ICF Kaiser Engineers, Inc. (ICF), 1995a] and data from 18 surface soil samples in Elk Neck State Forest in Cecil County (collected in 2003, in conjunction with the ERA toxicity test samples). The APG reference dataset identifies concentrations of naturally-occurring and anthropogenic analytes in off-post environmental media representative of conditions at APG.

4.1.2 Exceptions to Reporting Format Approach

Exceptions to the reporting format approach outlined in Section 4.1.1 are due to either: (1) the lack of comparison criteria, or (2) the migration potential of certain detected concentrations below the RI comparison criteria.

Some analytes do not have available RBCs, FAWQCs, or reference data. If no comparison criteria are available, then all concentrations of that chemical detected above the laboratory's detection limit are presented.

Analytes found at levels below the RI comparison criteria are also presented in cases where data interpretations show a continuing trend of contamination. For instance, if low-level contamination (below the RI comparison criteria) is detected in a well downgradient from a group of wells containing gross contamination, those lower concentrations will be presented to establish the total extent of impact. All detections of chlorinated VOCs were reported because of their tendency to migrate. Military-unique compounds, specifically CADPs and explosive-related compounds, are presented whether or not the analyte is below, above, or without comparison criteria.

4.1.3 Usability of Chemical Analysis Results

JEG Phase I RI surface media data (i.e., surface soil, sediment, and surface water) were validated in 1999-2000 by IT Corporation for use in the risk assessment. JEG subsurface soil data[4] were not validated, thus were not considered suitable for risk assessment use. [NOTE: The Phase I JEG subsurface soil data were, however, compared to the Phase III data for trend analysis.] Phase II data collected by EA were validated in accordance with USEPA Region III guidance.

Phase III Priority 1 RI samples[5] collected by GP in late-2004 were validated by URS Corporation in 2005. Data were validated to USEPA Region III Levels M-3 and IM-2, which are equivalent to Level IV. The data packages were reviewed following guidelines presented in the following documents:

- *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (USEPA Region III, 1993);
- *Region III Modifications to National Functional Guidelines for Organic Data Review* (USEPA Region III, 1994);
- *Region III Innovative Approaches to Data Validation* (USEPA Region III, 1995a); and,
- *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses* [Science Applications International Corporation, 2002].

During the data validation process, quality control samples, instrument calibrations, sample chromatograms, holding times, chain of custody forms, and sample handling procedures were reviewed. Based on this review, sample results were qualified and some analyses were rejected.

4.1.4 Evaluation of Laboratory and Field Contamination

Contaminants detected in laboratory method blanks or blanks collected in the field indicate that the contaminant could be present due to sample handling procedures. Sample results determined to be present from laboratory or field contamination are qualified "B" by the validator. Analytes that are common laboratory contaminants are qualified if detected at less than 10 times the blank

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[4] The electronic database containing the Phase I JEG subsurface soil data (initiated by IT Corporation during data validation efforts) is incomplete and has never been fully reviewed or validated (i.e., the scope of the data validation task was reduced to surficial media only because of funding limitations). Due to inconsistencies between the electronic data and tables presented in the *RI Progress Report*, GP did not generate data summary tables for the Phase I subsurface soil data. The data presented in the *RI Progress Report* (JEG, 1995b) are believed to be the most accurate; therefore, hard copies of the original JEG tables are provided for reference in Appendix D. The subsurface data are discussed briefly throughout Section 4.0.

[5] Phase III Priority 1 DPT groundwater data and Priority 2/3 soil data were not intended for risk assessment use (collected for nature and extent information only); therefore, were not validated.

concentration. All other analytes are qualified if detected at less than five times the blank concentration. Analytes determined by the validator to be due to blank contamination are not presented in the sample results summary.

4.2 to 4.21 (Provided in Draft RI Volume I - Northwest Region Sites, Volume II – Southwest Region Sites, and Volume III – East Region Sites)

Sections 4.2 through 4.7 were published in April 2006, in the draft *RI Report for Thirty-Five Remaining Soils Sites, Volume I: Canal Creek Main Industrial Area – Northwest Region* (GP, 2006b). Sections 4.8 through 4.15 were published in August 2006, in the draft *RI Report for Thirty-Five Remaining Soils Sites, Volume II: Canal Creek Main Industrial Area – Southwest Region* (GP, 2006c). Sections 4.16 through 4.21 were published in September 2006, in the working draft *RI Report for Thirty-Five Remaining Soils Sites, Volume III: Canal Creek Main Industrial Area – East* (GP, 2006d). As mentioned previously in Section 1.1 of this document (Volume IV), all four volumes of the draft RI will eventually be incorporated into one final document. Therefore, the numbering in this section for figures, tables, and appendices resume where they concluded in Volume III (i.e., beginning with Figure 33, Table 75, Appendix D-21, and Appendix E-21).

4.22 EACC3A – Building E3330 Laboratory Toxic Waste Disposal Pits

As discussed in Section 1.4.2, the Building E3330 Laboratory Toxic Waste Disposal Pits were used for the disposal of laboratory waste; including mustard, lewisite, chloropicrin, and contaminated lab equipment. The total area of the site is approximately 256,133 ft^2 or 5.88 acres.

RI sampling was conducted at EACC3A during the following phases:

- Phase I RI Sampling [geophysical survey, 4 soil borings (11 subsurface samples) and 1 groundwater sample];
- Phase II ERA Sampling [4 surface soil and 25 X-Ray Fluorescence (XRF) samples]; and,
- Phase III GP Sampling [2 soil borings with 2 subsurface soil samples (0-5 ft and 5-10 ft) per boring].

Sampling locations are shown on Figure 33. Results of chemical sampling are summarized in Tables 75 through 78 and discussed below. Laboratory data (detections only) and JEG RI tables (for Phase I subsurface soil only) are provided in Appendix D-21. Figures illustrating the detections of the primary COPCs are provided in Appendix E-21.